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Description

The present invention relates to a sheet glass heating method, and more particularly to a method of heating glass sheets for laminated glass.

Laminated glass, which finds wide use as front windshields of automobiles, is manufactured by heating first the second glass sheets to be paired in a heating furnace, shaping and annealing the glass sheets, and then joining the glass sheets face to face. The glass sheets may be shaped by a press shaping process, a gravity shaping process, or a roller shaping process. The first and second glass sheets are joined face to face by adhesive bonding with an intermediate film as of polyvinyl butyral sandwiched therebetween.

When the first and second glass sheets are to be bonded to each other, it is necessary that they be of a bent configuration having substantially the same shape. Basically, in a known method the first and second glass sheets are heated under the same conditions in the heating furnace which is kept at constant temperature so that they are at the same temperature To at the exit of the heating furnace. The first and second glass sheets are fed, alternately one by one, two by two, or three by three, into the heating furnace.

The first and second glass sheets, from which laminated glass is to be constructed, may not necessarily have the same characteristics, such as thicknesses, material properties, and coloured conditions, at all times. For example, the first and second glass sheets may have different thicknesses, or the first glass sheet may be a coloured transparent glass sheet whereas the second glass sheet may be a colourless transparent glass sheet. If the first and second glass sheets have such different characteristics, then they tend to be at different temperatures To at the exit of the heating furnace. As a result, the first and second glass sheets may not be shaped desirably, and may not appropriately be bonded to each other after they are shaped and annealed.

The present invention has been made in an effort to effectively solve the aforesaid problems of the conventional method of heating glass sheets for laminated glass.

It is an object of the present invention to provide a method of heating first and second glass sheets for laminated glass so that even if the first and second glass sheets have different characteristics, they can be at the same temperature To at the exit of a heating furnace, can be shaped to desired configuration, and can well be bonded face to face to each other after they are shaped and annealed.

According to the invention, there is provided a method of heating a first glass sheet and a second glass sheet which are to be combined into a single laminated glass sheet, in a heating furnace kept at constant temperature before the first and second glass sheets are shaped, the first glass sheet being heatable more easily than the second glass sheet, said method being characterised by moving the first and second glass sheets over the same distance through the heating furnace, whereby the first glass sheet is moved over said distance at an average speed which is so much higher than the average speed at which the second glass sheet is moved that the temperatures of the first and second glass sheets at the exit of the heating furnace are substantially equal to each other.

The above and further objects, details and advantages of the present invention will become apparent from the following detailed description of preferred embodiments thereof, when read in conjunction with the accompanying drawings.

FIG. 1 is a schematic plan view of a sheet glass bending apparatus which carries out a method of heating glass sheets for laminated glass according to a first embodiment of the present invention;

FIG. 2 is a fragmentary longitudinal cross-sectional view of a heating furnace of the sheet glass bending apparatus shown in figure 1;

FIG. 3A through 3C are views showing various sequences by which first and second glass sheets are heated;

FIG 4 is a schematic plan view of a sheet glass bending apparatus which carries out a method of heating glass sheets for laminated glass according to a second embodiment of the present invention; and

FIG 5 is a graph showing the relationship between heating times and temperatures at the exit of a heating furnace when various glass sheets are heated in the heating furnace which is kept at a constant temperature therein.

FIG 5 shows the relationship between heating times and glass temperatures at the exit of a heating furnace when four kinds of sheet glass are heated in the heating furnace which is kept at a constant temperature Ti therein. All the four glass sheets are sized 450mm x 450mm. The horizontal axis of the graph of FIG 5 represents a heating time t and the vertical axis represents the glass temperature To at the exit of the heating furnace. The characteristics of the heated glass sheets are indicated by respective curves X1, X2, Y1, Y2.

In the experiment to obtain the data shown in FIG 5, the heating furnace had ceramic rollers for feeding glass sheets and electric heaters inside of the furnace wall. The surface temperature of each of the heaters was controlled so as to be at a desired level by a thermocouple. Specifically, the surface temperature of the heaters above the rollers was kept at 660°C, and the surface tempera-

ture of the heaters below the rollers was kept at 650 °C.

Thickness Colour

- X1: 2.0mm Blue (= coloured transparent glass)
- X2: 2.3mm Blue (= coloured transparent glass)
- Y1: 2.0mm Colourless (= colourless transparent glass)
- Y2: 2.3mm Colourless (= colourless transparent glass)

It can be understood from FIG 5 that when the glass sheets are heated under the same conditions, the temperatures To of the coloured glass sheets at the exit of the heating furnace are generally higher than the temperatures To of the colourless glass sheets at the exit of the heating furnace. Comparison between the coloured glass sheets or the colourless glass sheets indicates that the glass temperature To at the heating furnace exit is higher if the glass sheet thickness is smaller.

If the shape, material property, or colour of a first glass sheet for laminated glass is different from the shape, material property, or colour of a second glass sheet, therefore, when the first and second glass sheets are heated under the same conditions, their temperatures To at the exit of the heating furnace are different from each other.

FIG 1 schematically shows a sheet glass bending apparatus, generally designated by the reference numeral 100, which carries out a method of heating glass sheets for laminated glass according to a first embodiment of the present invention. It is assumed that a single laminated glass sheet is constructed of first and second glass sheets G1, G2 and the first glass sheet G1 can be heated more easily than the second glass sheet G2.

The sheet glass bending apparatus 100 comprises a heating furnace 1 which is heated to a constant temperature Ti therein, a press machine 2 disposed downstream of the heating furnace 1, a lehr 3 disposed downstream of the press machine 2, and a pickup device 4 disposed downstream of the lehr 3. A succession of the first rollers (FIG 2), serving as a feed conveyor, is disposed in an upstream region in the heating furnace 1, for feeding the first and second glass sheets G1, G2 into the heating furnace 1. The first rollers 5 are arrayed over a distance L1 along the direction in which glass sheets are fed through the heating furnace 1. Another succession of second rollers 6, also serving as a conveyor, is disposed in the heating furnace 1, following the first rollers 5. The second rollers 6 are arrayed over a distance L3 along the glass sheet feeding direction. The first rollers 5 are rotatable selectively at different speeds such that they can feed glass sheets at a higher speed Vh and a relatively low constant speed Vl. The second rollers 6 are however rotatable at a fixed speed such that they can feed glass sheets at the relatively low constant speed Vl.

Initially, a single first glass sheet G1 is fed into the heating furnace 1 by the first rollers 5 and displaced over the distance L1 at the higher speed Vh. Then, the glass sheet G1 is delivered over the distance L3 at the lower speed Vl by the second rollers 6.

When the glass sheet G1 has traversed the distance L1, a second glass sheet G2 is introduced into the heating furnace 1 by the first rollers 5. At this time, the introduced second glass sheet G2 is fed over a distance L2, shorter than the distance L1, at the higher speed Vh. Then, the speed at which the second glass sheet G2 is fed is shifted from the higher speed Vh to the lower speed Vl by a control mechanism (not shown). The second sheet glass G2 is subsequently fed over a distance L4 at the lower speed Vl, the distance L4 satisfying the relationship: L1 + L3 = L2 + L4.

From the exit or terminal end of the heating furnace 1, the glass sheets G1, G2 are successively sent to the press machine 2 where they are pressed to shape.

When the first and second glass sheets G1, G2 are heated in the above fashion, the temperature To1 of the first glass sheet G1 at the exit of the heating furnace and the temperature To2 of the second glass sheet G2 at the heating furnace exit are equalized to each other. The ratio between the distances L1, L3, the ratio between the distances L2, L4, and the specific values of the speeds Vh, Vl are determined depending on the preset temperature Tin in the heating furnace 1 and desired temperatures To1, To2 of the glass sheets G1, G2 at the exit of the heating furnace 1.

Preferably, first and second glass sheets G1, G2 are introduced into the heating furnace 1 such that glass sheets G1, G2 to be paired into a laminated glass sheet are disposed closely to each other. When the glass sheets G1, G2 are heated in the manner described above, they are alternately introduced into the heating furnace 1 as shown in FIG 3A, and successive first and second glass sheets G1, G2 are combined into laminated glass sheets.

As shown in FIG 3B, sets of two first glass sheets G1 and sets of two second glass sheets G2 may alternatively be introduced into the heating furnace 1, and successive two glasses G1, G2 or successive two glasses G2, G1 may be combined into laminated glass sheets.

Alternatively, as shown in FIG 3C, sets of three first glass sheets G1 and sets of three second glass sheets G2 may alternatively be introduced

into the heating furnace 1, and each of the first glass sheets G1 in one set may be combined with the third following second glass sheet G2 in the next set, thereby making up a laminated glass sheet.

In the sheet glass bending apparatus 100, the first and second glass sheets G1, G2 are fed over the same distance (= L1 + L3 = L2 + L4) in the heating furnace 1, but the average speed at which the first glass sheet G1 that can be heated relatively easily is fed in the heating furnace 1 is higher than the average speed at which the second glass sheet G2 is fed in the heating furnace 1.

FIG 4 schematically shows a sheet glass bending apparatus, generally designated by the reference numeral 200, which carries out a method of heating glass sheets for laminated glass according to a second embodiment of the present invention. Those components shown in FIG 4 which are identical to those shown in FIG 1 are denoted by the identical reference numerals, and will not be described in detail.

The sheet glass bending apparatus 200 comprises a heating furnace 201 which is heated to a constant temperature Ti therein, a press machine 2, a lehr 3, and a pickup device 4 which are successively disposed downstream of the heating furnace 201.

Although not shown, the second rollers 6 are disposed in an upstream region in the heating furnace 1 and arrayed over the distance L3, and the first rollers 5 are disposed downstream of the second rollers 6 and arrayed over the distance L1 in the heating furnace 1.

In operation, a single first glass sheet G1 is introduced into the heating furnace 201 by the second rollers 6 and fed over the distance L3 at the lower speed Vl. Then, the glass sheet G1 is fed over the distance L1 at the higher speed Vh by the first rollers 5 until the glass sheet G1 reaches the exit at the terminal end of the heating furnace 201.

While the glass sheet G1 is being fed over the distance L3, a second glass sheet G2 is introduced into the heating furnace 201 by the second rollers 6. The glass sheet G1 is fed over the distance L4 at the lower speed Vl first by the second rollers 6 and then by the first rollers 5. The second glass sheet G2 is further fed over the distance L2 by the first rollers 5 before it arrives at the exit at the terminal end of the heating furnace 201.

The glass sheets G1, G2 are successively fed from the terminal end of the heating furnace 201 to the next press machine 2, by which the glass sheets G1, G2 are pressed to shape.

In the heating method described above with reference to FIG. 4, the temperature To1 of the first glass sheet G1 at the exit of the heating furnace and the temperature To2 of the second glass sheet G2 at the heating furnace exit are equalized to each other. More specifically, in the sheet glass bending apparatus 200, the first and second glass sheets G1, G2 are fed over the same distance (= L3 + L1 = L4 + L2) in the heating furnace 201, but the average speed at which the first glass sheet G1 that can be heated relatively easily is fed in the heating furnace 201 is higher than the average speed at which the second glass sheet G2 is fed in the heating furnace 201.

In the heating furnaces 1,201 shown in FIGS 1 and 4, respectively, the first rollers 5 which are rotatable selectively at different speeds are disposed in one of the upstream and downstream regions in the heating furnace. However, the first rollers 5 may be disposed so as to exist over the entire length of the heating furnace, and may be controlled so as to rotate selectively at different speeds.

The heating methods to be carried out by the sheet glass bending apparatus 100, 200 have to meet only one requirement that the average speed at which the first glass sheet G1 is fed in the heating furnace be higher than the average speed at which the second glass sheet G2 is fed in the heating furnace. Therefore, with the lower speed V1 and the higher speed Vh being set to suitable values, only the first glass sheet G1 may be fed at the higher speed through a portion of the heating furnace and the second glass sheet G2 may be fed at the lower speed over the entire length of the heating furnace.

With the heating methods according to the present invention, as described above, the temperatures To1, To2, at the exit of the heating furnace, of first and second glass sheets G1, G2 which are to be combined into a laminated glass sheet and which have different characteristics are equalised to each other. Therefore, the glass sheets G1, G2 can be pressed or otherwise processed into a desired shape. As a consequence, the glass sheets G1, G2 can well be bonded to each other after they have been shaped and annealed.

In the illustrated embodiments, it is necessary that the temperatures To1, To2 of the first and second glass sheets G1, G2 at the exit of the heating furnace be equal to each other.

Although there have been described what are at present considered to be the preferred embodiments of the present invention, it will be understood that the invention may be embodied in other specific forms without departing from the scope of the claims.

Claims

1. A method of heating a first glass sheet (G1) and a second glass sheet (G2) which are to be combined into a single laminated glass sheet, in a heating furnace (1,201) kept at constant temperature before the first and second glass sheets (G1, G2) are shaped, the first glass sheet (G1) being heatable more easily than the second glass sheet (G2), the said method being characterised by,

   moving the first and second glass sheet (G1, G2) over the same distance through the heating furnace (1,201), whereby the first glass sheet (G1) is moved over said distance at an average speed which is so much higher than the average speed at which the second glass sheet (G2) is moved that the temperatures of the first and second glass sheets at the exit of the heating furnace are substantially equal to each other.

2. A method of heating a first glass sheet (G1), and a second glass sheet (G2) as claimed in claim 1, characterised in that at least the first (G1), of said glass sheets (G1, G2) is moved through the heating furnace (1,201) selectively at a constant speed and a higher speed, whereby said first glass sheet (G1) is moved over a longer distance at the higher speed than the distance over which the second glass sheet (G2) is moved at the higher speed.

3. A method of heating a first glass sheet (G1) and a second glass sheet (G2) as claimed in claim 1 or 2, characterised in that the glass sheets (G1, G2) are moved serially along a first section of the furnace in which section the speed is adjustable to a first speed or a second higher speed;

   the distance in the first section along which the first glass sheet (G1) is moved at the second speed is varied so that the first glass sheet (G1) is in the first section for a shorter time than the second glass sheet (G2) and ;

   the glass sheets (G1, G2) are moved serially along a second section of the furnace at the first speed.

4. A method of heating a first glass sheet (G1) and a second glass sheet (G2) as claimed in claim 3, characterised in that the first section of the furnace (1) is located in front of the second section of the furnace (1) in the direction of travel of the glass sheets (G1, G2).

5. A method of heating a first glass sheet (G1) and a second glass sheet (G2) as claimed in claim 3, characterised in that the first section of the furnace (201) is located behind the second section of the furnace (201) in the direction of travel of the glass sheets (G1, G2).

Patentansprüche

1. Verfahren zum Erhitzen einer ersten Glasscheibe (G1) und einer mit der ersten Glasscheibe zu einer einzelnen Verbundglasscheibe zu kombinierenden zweiten Glasscheibe (G2) in einem auf konstanter Temperatur gehaltenen Heizofen (1, 201), bevor die ersten und zweiten Glasscheiben (G1, G2) geformt werden, wobei die erste Glasscheibe (G1) einfacher zu erhitzen ist als die zweite Glasscheibe (G2), wobei das Verfahren gekennzeichnet ist durch

   Bewegen der ersten Glasscheibe (G1) und der zweiten Glasscheibe (G2) über die gleiche Distanz durch den Heizofen (1, 201), wobei die erste Glasscheibe (G1) über diese Distanz mit einer durchschnittlichen Geschwindigkeit bewegt wird, welche um so viel größer ist als die durchschnittliche Geschwindigkeit, mit der die zweite Glasscheibe (G2) bewegt wird, daß die Temperaturen der ersten Glasscheibe und der zweiten Glasscheibe am Ausgang des Heizofens im wesentlichen einander gleich sind.

2. Verfahren zum Erhitzen einer ersten Glasscheibe (G1) und einer zweiten Glasscheibe (G2) nach Anspruch 1, dadurch gekennzeichnet, daß zumindest die erste (G1) der Glasscheiben (G1, G2) selektiv mit einer konstanten Geschwindigkeit und einer höheren Geschwindigkeit durch den Heizofen (1, 201) bewegt wird, wobei die erste Glasscheibe (G1) über eine längere Distanz mit der höheren Geschwindigkeit bewegt wird als die zweite Glasscheibe (G2).

3. Verfahren zum Erhitzen einer ersten Glasscheibe (G1) und einer zweiten Glasscheibe (G2) nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die Glasscheiben (G1, G2) seriell entlang eines ersten Abschnittes des Heizofens bewegt werden, wobei die Geschwindigkeit in diesem Abschnitt auf eine erste Geschwindigkeit oder eine zweite, höhere Geschwindigkeit einstellbar ist,

   daß die Distanz in dem ersten Abschnitt, längs der die erste Glasscheibe (G1) mit der zweiten Geschwindigkeit bewegt wird, so variiert wird, daß die erste Glasscheibe (G1) für eine kürzere Zeit in dem ersten Abschnitt ist, als die zweite Glasscheibe (G2), und daß Glasscheiben (G1, G2) seriell längs eines zweiten Abschnitts des Heizofens mit der ersten Ge-

schwindigkeit bewegt werden.

4. Verfahren zum Erhitzen einer ersten Glasscheibe (G1) und einer zweiten Glasscheibe (G2) nach Anspruch 3, dadurch gekennzeichnet, daß der erste Abschnitt des Heizofens (1) in Richtung der Bewegung der Glasscheiben (G1, G2) vor dem zweiten Abschnitt des Heizofens (1) angeordnet ist.

5. Verfahren zum Erhitzen einer ersten Glasscheibe (G1) und einer zweiten Glasscheibe (G2) nach Anspruch 3, dadurch gekennzeichnet, daß der erste Abschnitt des Heizofens (201) in Richtung der Bewegung der Glasscheiben (G1, G2) hinter dem zweiten Abschnitt des Heizofens (201) angeordnet ist.

Revendications

1. Procédé de chauffage d'une première feuille de verre (G1) et d'une seconde feuille de verre (G2) qui sont destinées à être combinées en une seule feuille de verre stratifié, dans un four de chauffage (1, 201) maintenu à température constante avant que la première et la seconde feuilles de verre (G1, G2) ne soient mises en forme, la première feuille de verre (G1) pouvant être chauffée plus facilement que la seconde feuille de verre (G2), ledit procédé étant caractérisé en ce qu'on déplace la première et la seconde feuilles de verre (G1, G2) sur la même distance à travers le four de chauffage (1, 201), de sorte que la première feuille de verre (G1) est déplacée sur ladite distance à une vitesse moyenne qui est beaucoup plus élevée que la vitesse moyenne à laquelle la seconde feuille de verre (G2) est déplacée, de sorte que les températures de la première et de la seconde feuilles de verre au niveau de la sortie du four de chauffage sont à peu près égales l'une à l'autre.

2. Procédé de chauffage d'une première feuille de verre (G1), et d'une seconde feuille de verre (G2) selon la revendication 1, caractérisé en ce qu'au moins la première (G1) desdites feuilles de verre (G1, G2) est déplacée à travers le four de chauffage (1, 201) de manière sélective à une vitesse constante et à une vitesse plus élevée, de sorte que ladite première feuille de verre (G1) soit déplacée sur une distance plus longue à la vitesse plus élevée que la distance sur laquelle la seconde feuille de verre (G2) est déplacée à la vitesse plus élevée.

3. Procédé de chauffage d'une première feuille de verre (G1), et d'une seconde feuille de verre (G2) selon la revendication 1 ou 2, caractérisé en ce que les feuilles de verre (G1, G2) sont déplacées en série le long d'un premier tronçon du four dans lequel la vitesse peut être réglée à une première vitesse ou à une seconde vitesse plus élevée,

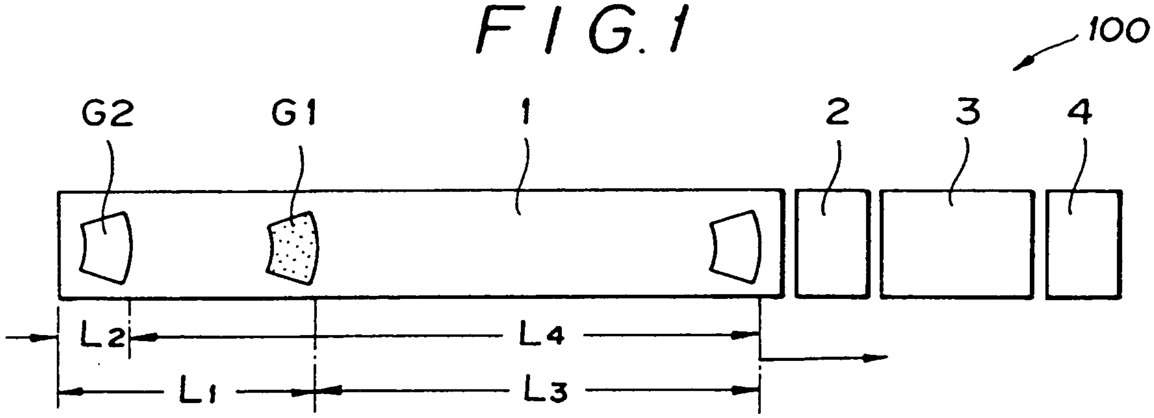
la distance existant dans le premier tronçon le long duquel la première feuille de verre (G1) est déplacée à la seconde vitesse est modifiée de sorte que la première feuille de verre (G1) soit dans le premier tronçon pendant un temps plus court que la seconde feuille de verre (G2) et,

les feuilles de verre (G1, G2) sont déplacées en série le long d'un second tronçon du four à la première vitesse.

4. Procédé de chauffage d'une première feuille de verre (G1), et d'une seconde feuille de verre (G2) selon la revendication 3, caractérisé en ce que le premier tronçon du four (1) est situé en avant du second tronçon du four (1) dans la direction de déplacement des feuilles de verre (G1, G2).

5. Procédé de chauffage d'une première feuille de verre (G1), et d'une seconde feuille de verre (G2) selon la revendication 3, caractérisé en ce que le premier tronçon du four (201) est situé derrière le second tronçon du four (201) dans la direction de déplacement des feuilles de verre (G1, G2).

FIG.1



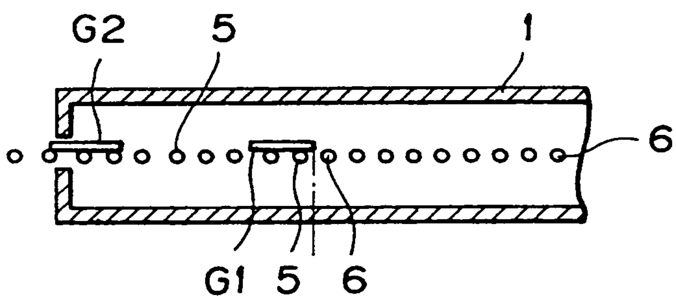
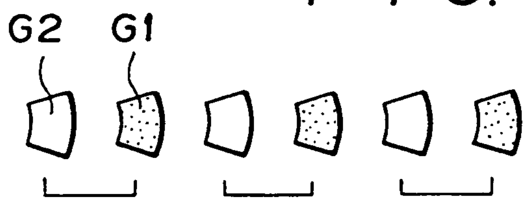


FIG.2

FIG. 3A



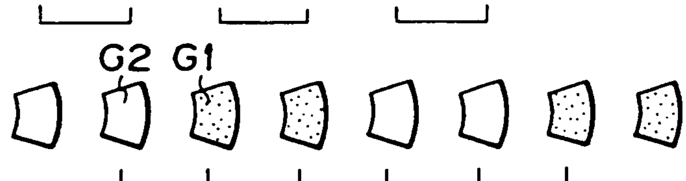


FIG. 3B

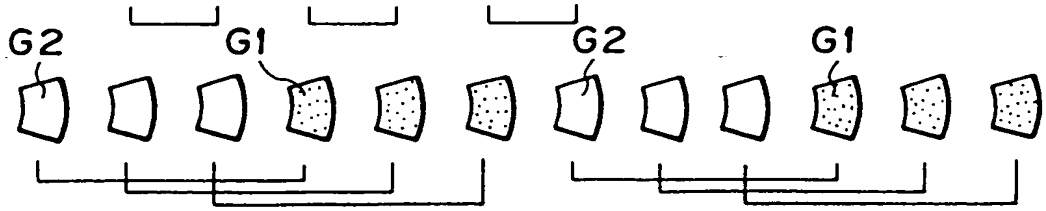


FIG. 3C

FIG.4

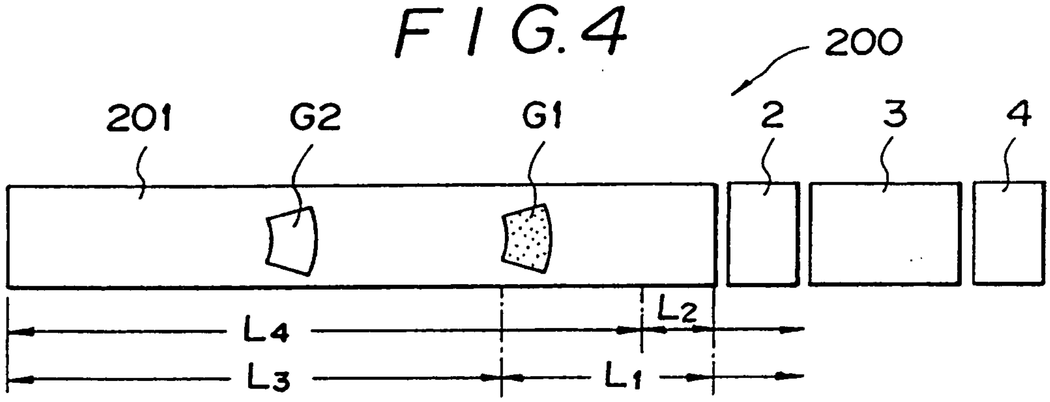
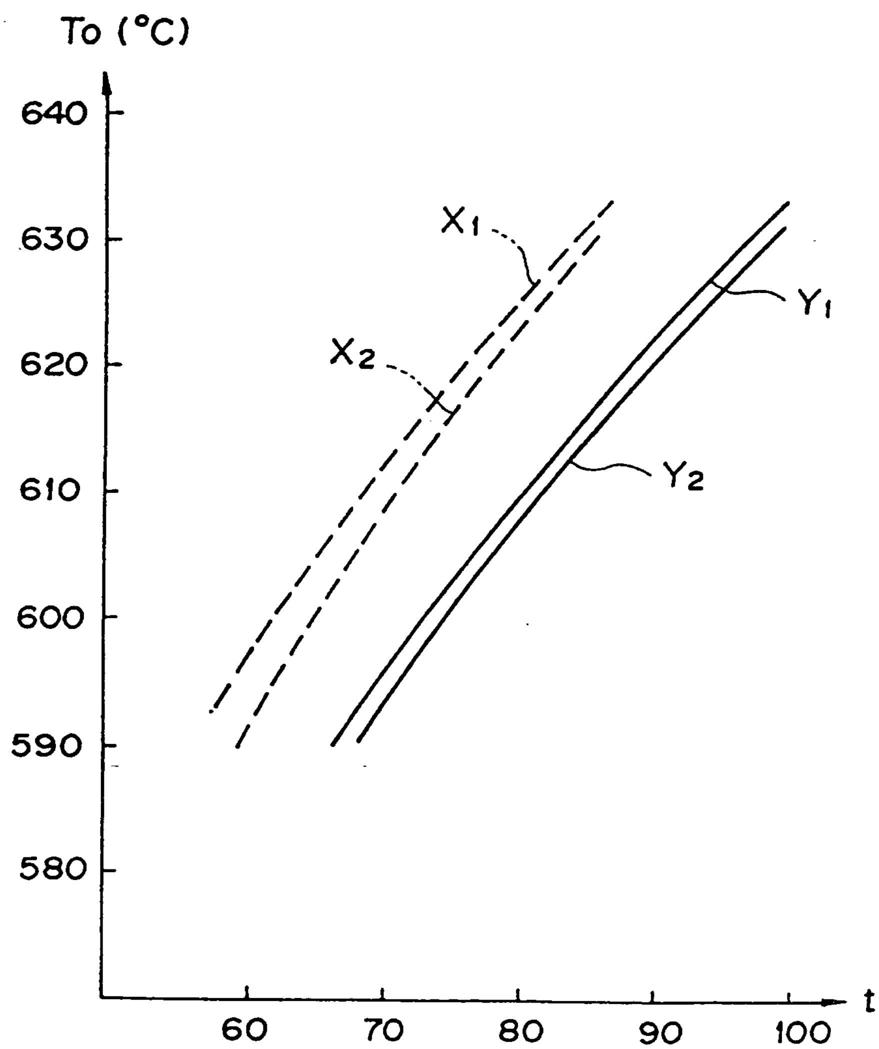

200
201
G2
G1
2
3
4
L2
L4
L3
L1

FIG.5


To (°C)
640
630
620
610
600
590
580
X1
X2
Y1
Y2
60
70
80
90
100
t